THE MONTANA DEPARTMENT OF TRANSPORTATION

TRAFFIC NOISE ANALYSIS AND ABATEMENT: POLICY AND PROCEDURE MANUAL

Prepared by
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1.0 INTRODUCTION

The Montana Department of Transportation (MDT) Highway Traffic Noise Policy is to be used in conjunction with the Montana Department of Transportation Noise Manual (Appendix A) and the Noise Abatement Recommendation Checklist (Appendix B). Together, these documents provide guidance for the analysis and abatement of highway traffic noise and fulfill requirements stemming from the following State and Federal environmental statutes:

- National Environmental Policy Act (NEPA), 23 CFR 771
- Title 23 United States Code of Federal Regulations, Part 772 (23 CFR 772), "Procedures for Abatement of Highway Traffic Noise and Construction Noise"
- Montana Environmental Policy Act (MEPA), Montana Codes Annotated Title 75

The policies and guidance provided in these documents are for use by the Montana Department of Transportation and its consultants for new construction or reconstruction transportation projects, and is to aid in the evaluation of the reasonableness and feasibility of noise abatement for the project.

This Policy provides guidance in determining the reasonableness of providing noise abatement and is not for determination of compensation on a remainder of a parcel during right-of-way negotiations.

Special terms used in this Policy have been defined for implementation purposes and can be found in Appendix C, Glossary.

Future versions of the Policy will be issued, as necessary, to incorporate changes in the laws, regulations, policy, procedures and practices pertaining to traffic and construction generated noise requirements and analysis.

1.1 Applicability

The MDT Highway Traffic Noise Policy applies only to Land Use Categories A and B, as defined in 23 CFR 772. Land Use Category A is for lands on which serenity and quiet are of extraordinary significance. Traffic noise studies for Land Use Category A will often fall under the application of Extenuating Circumstances (Section 5.2). Land Use Category B includes picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, hotels, motels, schools, churches, libraries and hospitals.

1.2 Construction Noise

Construction noise is not covered specifically by this Policy or by the MDT Noise Manual.

Construction noise is a temporary disturbance that can interfere with day-to-day activities. If there is a possibility that construction noise will be a sensitive and contentious issue, MDT or its consultants must follow the general steps outlined in 23 CFR 772.19 and FHWA Technical Advisory T6160.2, "Analysis of Highway Construction Noise" to identify and mitigate construction noise. In addition, road construction contractors are required to abide by all local noise ordinances.

2.0 AFFECTED PROJECTS

Currently, transportation projects affected by the Noise Manual and this Policy are *Type I Projects*. Type I and II Projects are defined and discussed in the next sections.

2.1 Type I Projects

A Type I Project is defined in 23 CFR 772 as follows:

> A proposed Federal or Federal-aid highway project for the construction of a highway on a new location, or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment, or increases the number of through-traffic lanes. More specifically, a Type I project is any project that has the potential to increase noise levels at adjacent receivers. Such a project specifically creates a totally new noise source, or increases the volume or speed of traffic or moves the traffic closer to receivers. The addition of an interchange/ramp/auxiliary lane/truck climbing lane to an existing highway is considered to be a Type I project. A project to widen an existing ramp by a full lane-width is also considered to be a Type I project.

2.2 Type II Projects

Type II Projects involve noise studies along existing highways in response to public complaints. This type of project is often referred to as a retro-fit project, and the noise study is not done in conjunction with a highway construction project. The Federal Highway Administration advises that Type II abatement projects for new activities and land uses which have come into existence after 1976 will not be approved unless an active land use control program was adopted by the local government prior to the existence of the new activities and land uses (Highway Traffic Noise Analysis and Abatement - Policy and Guidance, USDOT FHWA, June 1995).

The Federal Highway Appropriations Act of 1995 eliminated federal funding for Type II projects unless the noise barriers are proposed along lands that were developed or were under substantial construction before approval of the acquisition of rights-of-way for, or the construction of, an existing highway.

Funds available for retrofit noise abatement are in competition with other projects. The cost burden is often shared with the state and local governments. MDT does not currently have a Type II program, however, as the need for this type of program develops, MDT will consider updating the policy to include Type II abatement.

3.0 FEDERAL & STATE REQUIREMENTS

Under the National Environmental Policy Act (NEPA), impacts and measures to mitigate adverse impacts must be identified, including the identification of impacts for which no or only partial mitigation is possible.

The Montana Environmental Policy Act (MEPA), like NEPA, ensures that any project that has the potential to increase traffic noise impacts at receivers be evaluated. However, high-cost forms of noise abatement, such as barriers or berms will not be considered for non-Federal aid projects. MDT does not currently extend the Federal noise regulations to 100% state-funded projects.

The FHWA regulations in Section 3.1 below constitute the Federal Noise Standard. Projects complying with this Standard are also in compliance with the requirements stemming from NEPA & MEPA.

3.1 Federal Highway Administration (FHWA) Guidelines

Under FHWA regulations (23 CFR 772), noise abatement must be considered for Type I Projects when the project results in a *substantial noise increase*, or when the predicted noise levels *approach or exceed* the Federal Noise Abatement Criteria (NAC). Definitions for these terms are found in Section 4.0 of the MDT Noise Manual. Noise abatement measures which are *reasonable* and *feasible* and that are likely to be incorporated into the project, as well as noise impacts for which no apparent solution is available, must be identified and incorporated into the project's plans and specifications (23 CFR 772.11(e)(1) and (2)). A discussion of the reasonableness and feasibility of noise abatement can be found in Section 6.0 of this document.

4.0 ENVIRONMENTAL REVIEW REQUIREMENTS

As part of the general environmental review process associated with all projects, MDT or its consultants are required to evaluate whether the predicted noise levels could result in traffic noise impacts, and if so, consider and implement noise abatement if reasonable and feasible to do so. A copy of the initial noise analysis and all subsequent reports must be sent to the MDT Right-of-Way Bureau in addition to the designer (e.g., Bridge, Road Design, District Design, Consultant Design). The results of a preliminary noise abatement decision are reported in the draft environmental documentation as appropriate. If noise abatement is found to be reasonable and feasible, the final noise abatement decision occurs after the input from impacted residents and local agencies, and after consideration of cost, social, economic, environmental, legal, and technological factors. This decision, along with a complete copy of the entire noise analysis, is included in the final environmental document (e.g. EIS).

4.1 Date of Public Knowledge

The *date of public knowledge* of a proposed transportation project is used to determine if noise abatement should be considered as part of the project, or if noise abatement should be the responsibility of local government agencies or private developers. The date of public knowledge will be the date that a project's environmental analysis and documentation is approved, i.e., the date of approval of Categorical Exclusions (CEs), Findings of No Significant Impacts (FONSIs), or Records of Decision (RODs). After this date, MDT will only analyze changes in traffic noise impacts when requested by a unit of local government. After the date of public knowledge, MDT is no longer responsible for providing noise abatement for new development that occurs adjacent to the proposed highway project. Provision of such noise abatement becomes the responsibility of local communities and private developers.

4.2 Development that is Planned, Designed and Programmed

When traffic noise impacts are predicted for undeveloped lands for which development is *planned, designed and programmed* before the date of public knowledge, noise abatement must be considered as part of the project. Development is considered planned, designed and programmed on the date that a noise sensitive land use (such as subdivision, residences, schools, churches, libraries and hospitals) has received final

development approval (generally considered to be the issuance of a building permit) from the local agency with jurisdiction.

4.3 Levels of Traffic Noise Analysis

All proposed projects affected by this Policy should first be screened to determine if a full traffic noise analysis is warranted. The procedure is outlined in MDT's Noise Manual.

If the project requires a full noise analysis, a report and results of findings, including preliminary noise abatement design, will be included in the draft environmental document. A final noise abatement decision, if necessary, will be included in the final environmental document.

4.4 Coordination with Local Agencies and Officials

Highway traffic noise should be reduced through a program of shared responsibility. Local governments should use their authority to regulate land development in such a way that noise-sensitive land uses are either prohibited from being located adjacent to a highway, or that developments are planned, designed, and constructed in such a way that noise impacts are minimized.

It is MDT's policy to furnish the results of highway traffic noise analyses -- for those projects which pass through or adjacent to undeveloped lands, and for which traffic noise impacts have been identified -- to local government officials. Local coordination will be accomplished through the distribution of highway project environmental documents and noise study reports. MDT encourages local communities and developers to practice noise compatible development.

The likelihood that an area considered for noise abatement would change land-use designation within the life cycle of the project should be considered. Working with the local agency responsible for the land-use designation (i.e., city or county) will determine if redevelopment of the subject area is a strong possibility (e.g. residential to commercial). If redevelopment results in a change to a commercial or mixed residential-commercial nature, noise abatement will not be considered reasonable.

5.0 CONSIDERATION OF TRAFFIC NOISE ABATEMENT

Traffic noise abatement measures will be considered when traffic noise impacts are identified through the detailed highway traffic noise analysis outlined in the MDT Noise Manual. The noise abatement measures must be found reasonable and feasible (Section 6.0) prior to implementation. The traffic noise analysis document will contain a discussion of the reasonableness and feasibility of abatement measures considered. If it is determined that noise abatement measures will not be implemented, then the decision-making process must be documented in the report. The Noise Abatement Consideration Checklist should be completed and included in the noise analysis document.

5.1 Noise Abatement Measures

When noise impacts are shown to exist on a project, a number of possible abatement measures may be considered, including but not limited to:

1. Avoiding the project impact by using design alternatives that result in lessening the noise effect, such as altering the horizontal and/or vertical alignments.

2. Constructing noise barriers (sound walls or earth berms) within the highway project's right-of-way or easements.

3. Using traffic management measures such as modified speed limits, traffic control devices, time-use restrictions for certain vehicles, and the prohibition of certain vehicle types.

4. Insulating and/or air conditioning public use or institutional structures.

5.2 Extenuating Circumstances – Special Cases

There may be extenuating circumstances where unique or unusual conditions warrant special consideration of noise abatement measures. These circumstances could include historically significant areas or the presence of any long term efforts to maintain the character or cultural value of a sensitive area.

6.0 REASONABLENESS AND FEASIBILITY OF NOISE ABATEMENT

Noise abatement is only considered where noise impacts affect areas where frequent human use occurs. In addition, it must be shown that a lowered noise level would be of benefit, with primary consideration given to exterior areas. In situations where no exterior activities are affected by the traffic noise or where the exterior activities are far from or physically shielded from the roadway and therefore not impacted, the interior criterion (Category E in Table 1) will be used as the basis for noise abatement consideration.

There are two main elements in the consideration of noise abatement: reasonableness and feasibility. The criteria and procedures used to determine reasonableness and feasibility should be objective enough to be quantifiable but flexible enough to allow MDT to make meaningful judgments on a case-by-case basis.

The decision to provide noise abatement for a highway project is made by a multi-disciplinary team of MDT and local representatives. Their decision will be based on careful consideration of the criteria described in the following sections. The decision team will consist of members from three or more of the following groups:

1. MDT Environmental
2. MDT Preconstruction
3. MDT Right-of-Way
4. MDT District Engineering Services Supervisor
5. MDT Materials & Research
6. MDT Maintenance
7. Local government

A Noise Abatement Recommendation Checklist should be filled out when considering reasonableness and feasibility of abatement. The checklist is found in Appendix B.

6.1 Feasibility Criteria

Feasibility deals with engineering and acoustical considerations of the project such as topography, access, drainage, safety, and whether other noise sources are present. Safety and maintenance considerations may dictate whether or not a noise barrier is feasible. Some safety limitations that would make a noise barrier, such as a wall, unfeasible are excessive restriction of sight distance, continuous shadow causing icing of the driving lanes, or severe drainage problems associated with the barrier.

For the construction of noise barriers such as sound walls, MDT uses, as a guideline, an insertion loss of at least 6 dBA for the abatement measure to be considered feasible. This insertion loss applies to *first row homes*. This requirement ensures that for the cost to provide noise abatement, a commensurate reduction in noise levels will be achieved.

6.2 Reasonableness Criteria

The reasonableness evaluation of a proposed abatement measure is more subjective than the evaluation of feasibility or the determination that a noise wall can provide at least a 6 dBA reduction in noise. Reasonableness implies the use of common sense and good judgement, and an evaluation of costs associated with noise abatement.

The overall reasonableness of noise abatement is determined by considering a multitude of factors including the following:

1. Cost per impacted receiver per decibel reduction in noise (Section 6.3)
2. Comparison of existing to future noise levels
3. Noise abatement benefits
4. Additional considerations that may include cultural and community values, frequency of use, aesthetics
5. Desires of impacted residents or organizations
6. Development trends and land use controls
7. Life cycle of noise abatement benefits

The factors 6 and 7 above should be considered in the preliminary reasonableness decision. In an area where development trends are changing from residential to commercial, it won't be reasonable to construct a wall where planned future use would limit the wall's useful life to less than 15 years.

6.3 Cost of Abatement

Generally, for land use category B and primarily for residences, a reasonable cost of noise abatement can be considered by calculating a Cost Effectiveness Index (CEI), which takes into consideration the insertion loss the barrier will provide and the number of *benefited receptors*.

The CEI should be calculated for each barrier or barrier segment. The units of CEI are: $ $ ÷ dBIL ÷ BR.

Where:

$ $ = Total barrier cost, not including right-of-way acquisition and utility relocation.
DBIL = Average weighted insertion loss of benefited receptors, in dBA
BR = Number of benefited receptors in the study zone

The CEI is calculated based upon the noise reduction received at sensitive receptors in the study zone. The study zone is defined as the area 150 meters (500 ft.) back from the edge of the roadway directly behind the barrier.

A barrier that has a cost effective index greater than $4200 is not considered reasonable to build. This is just one factor in the determination of what is reasonable for building a barrier.

6.4 Preliminary Reasonableness Consideration for Non-Residential Areas in Category B

When analyzing the reasonableness and feasibility of noise abatement for impacted receivers other than residences, a more subjective approach is needed. Barrier cost may not be an adequate determining factor when considering noise abatement for schools, churches, hospitals, hotels and motels, and other potentially noise sensitive buildings in land use activity category B (Table 1). In addition, FHWA will participate in insulation of public-use structures. Costs for insulating against noise need to be weighed with costs for noise barriers, along with all the other reasonableness and feasibility criteria considered for noise impacts in residential areas.

Cost of abatement for parks, recreational and picnic areas in activity category B will be determined on a case-by-case basis, with only the areas of frequent human use considered for noise abatement.

For Activity Category A (Table 1) -- Lands on which serenity and quiet are of extraordinary significance -- noise abatement reasonableness and feasibility will be considered on a case-by-case basis. In addition to cost, other factors to consider for this type of land use are:

- importance with respect to public need
- importance of the serene and quiet qualities with respect to the area's intended purpose
- frequency, duration and hours of human use

6.5 Desires of Impacted Residents

The desires and opinions of impacted residents will be a major consideration in reaching a final decision on the reasonableness of proposed noise abatement measures. The opinions of the impacted residents, on whether they favor construction of the proposed noise abatement, materials used, and landscaping should be obtained through public hearings, community meetings, or other means as appropriate. In the case of rental or

leased property, the owners' opinions are superior to that of the residents. Noise abatement will not be provided if more than 50% of the affected residents do not want it. Use of visual simulations to show impacts created by sound walls is recommended in the public input process.

7.0 FINAL NOISE ABATEMENT DECISION

Once a preliminary report on traffic noise impacts and a noise abatement decision has been submitted, public input will be solicited as part of the NEPA process, including the views of impacted residents and/or local agencies, which will also aid in the decision to provide noise abatement.

The appropriate environmental documentation (e.g. Draft Environmental Impact Statement) serves as a vehicle to circulate the preliminary noise abatement decision. If noise abatement is proposed, the design is based on preliminary project alignments and profiles, which may be subject to change. The document should (1) report that the physical characteristics of the abatement (e.g. length, height, location and material of noise barrier) are preliminary and (2) include a statement such as the following:

> *If pertinent parameters change substantially during the final project design, the preliminary noise abatement design may be changed or eliminated from the final project design. A final decision of the construction of the noise abatement will be made upon completion of the project design.*

7.1 Final Noise Abatement Decision and Final Environmental Document

The final noise abatement decision is a product of public input as well as the preliminary noise abatement decision. Although the draft environmental document serves as a starting point in the final noise abatement decision, the decision makers have an obligation to balance a variety of public objectives. These include specific economic, environmental, social, legal and technological factors as well as other public opinions and the views of the impacted residents. Once this public input process is complete, the final noise abatement decision is included in the Record of Decision (ROD) or Finding of No Significant Impact (FONSI). The noise analysis report, including computer modeling data and documentation of the decision to provide or not provide noise abatement is all included in the final environmental document as an appendix.

THE MONTANA DEPARTMENT OF TRANSPORTATION

HIGHWAY TRAFFIC NOISE ANALYSIS PROCEDURE MANUAL
Appendix A

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1.0 INTRODUCTION

This manual provides guidelines and recommendations for conducting traffic noise analysis in the state of Montana and should be used in conjunction with the Montana Department of Transportation Noise Policy, which provides guidance in determining noise abatement options. Italicized terms are defined in Appendix A – Glossary, or other stated reference.

The policies and guidance provided in these documents are for use by the Montana Department of Transportation and its consultants for new construction or reconstruction transportation projects, and are to aid in the evaluation of the reasonableness and feasibility of noise abatement for the project. They are not to be used for determining compensation on a remainder of a parcel during right-of-way negotiations.

1.1 Qualifications Necessary To Do Noise Analysis

Only qualified personnel can perform highway traffic noise analysis for the Montana Department of Transportation (MDT). Qualified personnel are those who have successfully completed training in the area of Highway Noise Analysis – either through the Federal Highway Administration, University of Louisville, and/or the Vanderbilt University, or other qualified provider.

The persons must have demonstrated experience in conducting noise analysis studies for highway transportation projects and must have exhibited a working knowledge of procedures outlined in FHWA Report Number FHWA-PD-96-046, "Measurement of Highway-Related Noise," and Title 23 CFR Part 772. All persons performing noise analyses must also be proficient with the use of the most currently approved FHWA traffic noise prediction model and be ready, willing and able to support their analyses with expert testimony if required.

2.0 TRAFFIC NOISE ANALYSIS PROCEDURE

For *Type I projects* all viable alternatives under consideration must be analyzed for traffic noise impacts. If traffic noise impacts are identified, noise abatement must be considered. Any noise abatement measures found to be reasonable and feasible are included in the draft environmental document. Refer to Montana Department of Transportation's Noise Policy for a discussion of the reasonableness and feasibility of providing noise abatement.

This section describes noise analysis procedures applicable to Montana Department of Transportation highway projects. The contents of this section are consistent with methods described in the FHWA document FHWA-PD-96-046, *"Measurement of Highway-Related Noise,"* May 1996.

2.1 Highway Traffic Noise Preliminary Screening Procedure

A preliminary screening of a project is required to determine if a detailed noise analysis, including preliminary design of noise abatement is necessary. The preliminary screening can usually be completed shortly after the distribution of the Preliminary Field Review Report (PFRR). The following is a guideline for the screening process:

1. Determine if the project is a Type I project as described in 23 CFR 772. If project is not a Type I project, no further analysis is needed unless, through the project scoping process, potential noise issues are identified.

2. If the project is an existing roadway on a new alignment or with alignment shifts, determine if there are potentially *impacted receivers* (see Appendix A – Glossary) within 150 m (500 ft) of the roadway, including developments that are *planned, designed and programmed*, but not yet constructed. If there are no potentially impacted receivers present or planned, no further analysis is necessary.

3. If the project is on an existing alignment or one with minor alignment shifts, determine if shielding or lack thereof of the receivers will be the same or improved after the project. If existing shielding will be eliminated or otherwise compromised, a detailed analysis is required.

4. If existing noise levels already approach or exceed the NAC (Section 4.0), then a detailed noise analysis is required. It will likely be necessary to take ambient noise measurements to determine if noise levels approach or exceed the NAC (Section 3.0).

5. If traffic volumes are very low (ADT < 300), and are not expected to double in the design year, a detailed noise analysis is not required.

6. If the project does not qualify as a Type 1 project, but is new construction which will create a traffic configuration that may affect potential receivers (such as a weigh station, rest area, or passing/climbing lanes), a detailed noise analysis may be required.

7. If it is determined that the project does not require a noise analysis, submit a brief report or statement to the appropriate office (MDT Consultant Design, MDT Environmental, etc.) to be included in an environmental document or draft environmental document.

2.2 Highway Traffic Noise Detailed Analysis

The detailed noise analysis may be conducted after a preliminary noise screening of the project indicates that a higher level of analysis is warranted. It may also be used in place of a preliminary screening when it is clear that noise impacts will occur on the project.

A detailed noise analysis involves measuring ambient noise levels at selected receivers, verifying the computer model, and modeling design year noise levels using projected traffic volumes and all alignments considered in the environmental document. The computer traffic noise model used must be an FHWA-approved model. Currently acceptable models are STAMINA (FHWA-RD-77-108) and FHWA TNM Version 1.1; however, the STAMINA model will no longer be acceptable after December 31, 2002. The following steps illustrate a typical detailed noise analysis, but are not meant to be all-inclusive instructions.

1. Obtain existing and design year traffic data and preliminary plans showing all alignments considered. If no plans are available, obtain translites or other graphics to illustrate the locations of all alignments considered.

2. Identify existing land use activities, developed lands, and undeveloped lands for which development is planned, designed and programmed which may be affected by noise from the highway.

3. Conduct a field visit and determine which receivers will be potentially impacted and which receivers or locations will best represent potentially impacted receivers (see Sections 3.1 and 3.2).

4. Measure ambient noise levels at selected receivers/locations (section 3.0).

5. Check model against ambient noise level measurements and traffic counts. If modeled decibel levels are within 2 dBA of measured levels for same condition, the model is verified. If there is a difference of more than 2 dBA, there must be an explanation in the noise report for the differences between measured and modeled noise levels. When modeled levels are lower than recorded levels, it may indicate an additional noise source (for example, the hum of a refinery or other industrial noise). If modeled noise levels are higher than measured levels, there may be some attenuation in the field that is not being accounted for in the model (in which case a review and correction of the input data may be warranted).

6. Run the traffic noise model for three different scenarios:

   a.) for existing (present year) traffic volumes, using peak hour projected traffic volumes for selected receivers;

   b.) for all alternatives using design year “build” projected traffic volumes, and

   c.) for the design year “no build” scenario.

7. Tabulate the results of the noise model, and determine if and at what receiver locations noise impacts occur (Section 4.0).

8. For traffic noise impacts, analyze the reasonableness and feasibility of noise abatement (MDT Noise Policy). This may require modeling the use of sound walls or earth berms.

9. Compile a report of traffic noise impacts, a discussion of reasonableness and feasibility of all proposed abatement measures, and a description of proposed sound walls or berms, if applicable. This document will be included in the draft environmental document, and in the case of proposed sound walls or berms, it will be used for the final noise abatement decision process (MDT Noise Policy).

3.0 AMBIENT NOISE MEASUREMENTS

In the noise analysis, the ambient noise measurements are used to determine existing noise levels and to calibrate the noise prediction model. They can also be used to analyze the effectiveness of noise abatement measures. The Federal Highway Administration document, "Measurement of Highway-Related Noise," FHWA-PD-96-046, May 1996, should be consulted prior to undertaking field noise measurements.

As discussed in the previous section, existing noise levels should be determined by field measurements to verify the computer model and determine additional noise sources. However, when modeling noise levels to determine impacts, the present and design year traffic data, not the field traffic counts, are used. If there is a wide discrepancy between actual traffic counts and projected volumes for present-day traffic flow, it may be necessary to verify or alter the projected volumes to better reflect actual counts.

The following steps are general guidelines for taking ambient noise measurements:

1. Be sure that meteorological and pavement conditions are adequate for noise measurements (Section 3.4).

2. Set up field monitoring equipment, calibrate instrument, record meteorological conditions.

3. Begin noise measurement for recommended duration, dependent on traffic flow (Section 3.5). During measurement, tally traffic according to *vehicle class* (Section 3.6).

4. Repeat measurement as necessary (Section 3.7).

3.1 Receivers

Potentially impacted receivers may exist along a highway project. These receivers need to be identified within their corresponding land-use activity categories and examined for future noise impacts. It is not usually reasonable or possible to examine the impacts at all receivers in a project corridor. Receivers that are *acoustically representative* (Appendix A - Glossary) should be carefully selected for the noise analysis. Following are some general recommendations for selecting receivers:

1. Select receivers generally in locations that are now receiving or are expected to receive the highest noise levels over the period covered by the analysis. Since, in most cases, impacts will be at receivers closest to the highway, the vast majority of receivers should be in the first row of residences relative to the project alternative. A few exceptions include:

    a.) Projects where realignment would move the noise sources toward receivers other than those adjacent to the existing alignment; and

    b.) Projects involving geometry where homes closer to the highway are partially shielded and homes further from the highway may actually receiver higher noise levels, for example roadways on high embankments.

2. Coincide a noise measurement with a receiver, unless the selected receiver is not in a good accessible location for setting up a noise meter, or if is not possible to get permission to access the property. In either case, a noise measurement site acoustically representative of the receiver should be selected in a more accessible location.

3. Include other noise-sensitive locations, such as libraries, churches, hospitals, schools, and parks. For public use structures where interior noise is a concern, refer to Section 3.2 #4.

4. Receivers are 1.5 meters (5 feet) above the ground elevation, unless dictated by unusual circumstances. Exceptions would include placing a receiver 1.5 m above a wood deck of a house situated on a steep slope, instead of 1.5 m above the ground. Second story levels are not generally used as receivers, because exterior uses are negligible and noise abatement for second story receivers is usually not reasonable or feasible.

5. Select receivers in areas of frequent human use. There is little need to address noise impacts in areas where people do not spend much time (for example, parking lots).

3.2 Noise Measurement Locations

Once the receivers have been chosen, select noise measurement locations at each receiver. The following are some recommended site characteristics common to all outside noise measurement sites:

1. Sites should be clear of major obstructions; reflecting surfaces such as walls of residences should be more than 3 m (10 ft) from the microphone.

2. Sites should be free of noise contamination by sources other than those of interest. Avoid sites located near barking dogs, lawn mowers, playgrounds, and the like, unless it is the express intent to measure noise from these sources.

3. Noise measurement locations should be acoustically representative of areas and conditions of interest. They should either be located at, or represent, locations of frequent human use (i.e., backyard patio/barbecue).

4. When an outside area of frequent human use is not present (for example, classroom noise measurements), measurements should be made at a point in the room where people would be impacted by infiltrating noise from the sources of interest. These are typically locations near windows. Several sensitive points may need to be tested and the results averaged. The measurement should not be made within 1-1.2m (3-4 ft) of a wall. Fans, ventilation, clocks, appliances, telephones, etc., should be turned off.

3.3 Measuring Times

FHWA 23 CFR 772 requires that traffic characteristics, which yield the *worst-case noise hour* on a regular basis, be used for predicting noise levels and assessing noise impacts. Therefore, if the purpose of the noise measurements is to determine a future noise impact by comparing predicted noise levels with measured noise levels; the measurements must reflect the highest existing hourly noise level that occurs regularly.

In most cases, experience has shown that the *peak traffic hour* is the worst-case noise hour. However, on occasion, conditions such as capacity, effects on vehicle speed, higher than normal off-peak truck percentages, or unusual hourly traffic distribution may cause the worst-case noise hour to be different from the peak traffic hour.

Preliminary noise measurements at various times of the day are sometimes necessary to determine the noisiest hour. In some parts of the state, residents may be impacted by nighttime or early morning truck noise, which can seem louder due to the time of day the noise occurs and the heavier volume of trucks. And, in some cases, weekly and/or seasonal variations need to be taken into consideration. In recreational areas, weekend traffic may be greater than on weekday and heavily influenced by season. Often it is helpful to talk to residents to determine the heaviest traffic times and noisiest times of day.

If it is determined that the worst case noise hour occurs between a time of 10pm and 7am, it may be necessary to apply a *day-night averaged sound level (Ldn)* to the measured noise levels. This ensures that noise impacts occurring during the sleeping hours, which may cause sleep disturbance, are adequately addressed.

3.4 Meteorological Constraints

Warm, calm, sunny days are best for measuring traffic noise; however, these conditions occur in Montana for only a short time during the year. Repeat noise measurements need to be made during similar meteorological conditions, so documentation of existing conditions is very important. However, noise measurements should NOT be made when one or more of the following meteorological conditions exist(s):

1. wind speeds of more than 19 km/h (12 mi/h) for routine highway noise measurements,

2. manufacturer's recommendations for acceptable temperature and humidity ranges for instrument operation are exceeded; and

3. during rain, snow, or wet pavement conditions.

Wind effects on noise levels are caused by refraction of the noise rays due to wind shear near the ground. Noise rays are bent upward upwind, and downward downwind. The result is the decrease of noise upwind and an increase of noise downwind from a source. Thus, in order to compare noise measurements for agreement, all site, traffic, and meteorological conditions must be as close to the same as possible. Wind speed and direction should be recorded prior to each measurement, and it is recommended that wind speed and direction be checked again after each measurement.

3.5 Measurement Duration

A noise measurement representing an hourly Leq does not need to last the entire hour. As long as noise levels do not change significantly, a shorter time period will usually be sufficient to represent the hour of interest. The recommended length of measurement depends on how much the noise levels fluctuate, which is dependent on vehicle spacing and vehicle type. Noise fluctuations become less as traffic densities increase. Highway noise also becomes more constant as the distance from the highway increases because the rate of distance change between a moving vehicle and a receiver diminishes. If an hour-long measurement is not possible or warranted, use the following table to determine the duration of noise measurements:

Traffic volume (vehicle/hour/lane)	**Duration (minutes)**
High (>1000)	10
Medium (500-1000)	15
Low (<500)	20

Most sound level meters automatically integrate and digitally display cumulative Leq's. Near the beginning of each measurement period, the display fluctuates considerably; however, after more data is collected, the readings stabilize. A measurement may be terminated when the range of fluctuations in displayed Leq is less than 0.5 dBA.

3.6 Counting Traffic

When conducting ambient noise measurements for traffic noise analysis and model calibration, it is necessary to tally traffic according to vehicle class. FHWA-approved noise models (TNM or STAMINA) require traffic volumes be split into counts for automobiles, heavy trucks, medium trucks, and optionally in TNM, motorcycles and school buses.

During each ambient noise measurement, count traffic that passes by the noise meter according to the above-mentioned vehicle classes. For multiple lane and divided highway projects, count traffic in each direction separately (i.e., eastbound and westbound). For two-lane and low-volume roads, both directions of travel may be counted together.

Determine the speed of traffic passing the noise meter by using a radar gun, driving the project at the flow of traffic, or an alternate method. For some projects, vehicles of different classes may be traveling at different speeds; for example, heavy trucks traveling uphill may travel at slower speeds than automobiles. It is important to obtain the average speeds for all vehicle classes.

3.7 Number of Repetitions

Because of the potential errors and variables that may occur during a measurement, such as barking dogs, calibration error, operator error and changes in meteorology, it is recommended that a time-averaged measurement (Leq) be repeated at least once at each site within the same time period and for the same conditions. Repeat measurements should agree within 1 decibel, unless a change in conditions and traffic flow is noted. Repeat measurements that do not agree may indicate that a longer measuring duration is needed, or that the repeat measurements within the same time period should be averaged.

It is also recommended that at least two different time periods be measured at each site, for example, morning and evening rush-hours, or one rush-hour period and one noisiest hour period, if different from rush-hour.

During each noise measurement, whether counting traffic or not, meteorological conditions and other noise sources should be noted.

4.0 TRAFFIC NOISE IMPACTS

FHWA defines a noise impact as occurring when existing or design year noise levels *approach* or *exceed* the FHWA Noise Abatement Criteria (NAC), or when design year noise levels *substantially exceed* existing levels (23 CFR 772.5(g)). Table 1 lists the NAC for various land-use categories. FHWA has left it up to each individual state transportation agency to define *approach* and *substantially exceed*. Below are MDT's definitions of the terms:

Approach – Design year noise levels (Leq(h)) are predicted to be one decibel (dBA) below the levels shown for the land-use category in question in the Federal Noise Abatement Criteria (Table 1).

Substantially exceed –Design year noise levels (Leq(h)) are predicted to increase 13 decibels (dBA) above existing levels.

Noise abatement measures will be considered when either or both of the above conditions are met.

Noise abatement will not normally be considered for Activity Category C (commercial land use), or for areas of mixed land use that is dominated by or changing to Activity Category C. Also, noise abatement such as a wall or earth berm will not normally be considered where planned future use would limit its useful life to less than 15 years.

TABLE 1 - NOISE ABATEMENT CRITERIA FOR CONSIDERING TRAFFIC NOISE IMPACTS

NOISE ABATEMENT CRITERIA (NAC)		
ACTIVITY CATEGORY	Leq(h) dBA	DESCRIPTION OF ACTIVITY CATEGORY
A	57 Exterior	Lands on which serenity and quiet are of extraordinary significance and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 Exterior	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 Exterior	Developed lands, properties, or activities not included in Categories A or B above.
D	_____	Undeveloped lands.
E	52 Interior	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: 23 CFR 772

4.1 Noise Reports

Noise analysis reports are to be included in the Environmental Assessment or Environmental Impact Statement. The complete report, along with all documentation of the decision process for noise abatement must be included as an appendix to the environmental document. The following items should be included in noise reports:

1. Brief description of the project, including project location and limits, alignments considered, and surrounding land use.

2. Discussion of ambient noise measurements, including locations of measurements, dates and times, weather and traffic conditions, equipment used, measurement times, duration and repetitions. A table is useful to present conditions and noise levels.

3. A brief discussion of noise modeling parameters and calibration of the noise model with ambient noise measurements and traffic counts.

4. A table of modeling results for the three scenarios described in Section 2.2 #6 and a description of impacted receivers.

5. A discussion of the reasonableness and feasibility of noise abatement (refer to MDT Noise Policy), and if applicable, a description of the noise abatement option(s) to be pursued through the public comment process.

6. When applicable, a completed and signed Noise Abatement Recommendations Checklist (MDT Noise Policy Appendix A)

5.0 CONCLUSIONS

Once the noise analysis has been completed, a discussion of the reasonableness and feasibility of noise abatement should be included in the final report, including preliminary noise abatement design, cost, and public opinion. Refer to MDT's Noise Policy for guidance in this discussion. All noise analysis reports are to be reviewed by MDT and approved by FHWA.

Changes to the manual and policy will be made as needed. Additional copies of the manual and policy can be obtained by telephoning or writing to:

Noise Specialist
Montana Department of Transportation
Environmental Services
PO Box 201001
Helena, MT 59624-1001
406-444-7228

The documents can also be found on MDT's web site: http://www.mdt.state.mt.us/.

MDT attempts to provide reasonable accommodations for any known disability that may interfere with a person participating in any service, program or activity of the department. Alternative accessible formats of this document are available upon request. For further information call (406) 444-7659 (voice) or (406) 444-7696 (TTY).

APPENDIX B
NOISE ABATEMENT RECOMMENDATION CHECKLIST

Montana Department of Transportation

NOISE ABATEMENT RECOMMENDATION CHECKLIST

This form is to be used in conjunction with the MDT Noise Manual and Policy documents.

Section I – Feasibility Determination

1. Can a 6 dBA reduction in noise be achieved by constructing a noise barrier?

   _____Yes _____No

2. Can a noise barrier be constructed without creating a safety hazard to the users and residents, and without significantly interfering with operations and maintenance of the transportation facility?

   _____Yes _____No

If "yes" was answered to both questions above, proceed to the next Section.
If "no" was answered to either question, proceed to Section III.

Section II – Reasonableness Determination

1. Does the cost-effectiveness-index (CEI) exceed $4200?

   _____Yes _____No If yes, by how much?_____

2. Were the impacted receivers in existence prior to the original construction or widening of the existing highway?

   _____Yes _____No

   2a. What percentage of impacted receivers were in existence prior to the original construction or widening of the existing highway?

   _____ More weight is given to neighborhoods that were established prior to the construction of the existing highway.

3. Are there any city or county plans for noise-compatible development along existing public travel facilities?

   _____Yes _____No If No, contact local planning office.

4. Is the "build" noise level at least 3 decibels higher than the "no-build" noise level?

   _____Yes _____No If No, construction of a noise wall may not be reasonable. Weigh this factor with the modeled design year noise levels.

5. Would the noise barrier be in-use for at least 15 years?

   _____Yes _____No It is unreasonable to build a noise barrier in an area where changing development will limit its usefulness.

6. Do at least 60% of the impacted residents approve of the construction of a noise barrier in their neighborhood?

   _____Yes _____No It is unreasonable to build a noise wall that less than 40% of the impacted residents don't want. Weigh this item with other reasonableness factors.

Section III – Abatement Decision

REASONABLENESS & FEASIBILITY DECISION STATEMENT:

Are noise barriers or berms feasible? Yes____ No____

Are noise barriers or berms reasonable? Yes____ No____

Reason for Decision (use additional sheets if necessary):

Decision Committee Signatures: ***Printed Name And Title:***

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

APPENDIX C
GLOSSARY

GLOSSARY

A-Weighted Sound Level (dBA): The sound pressure levels in decibels measured with a frequency weighting network corresponding to the A-scale on a standard sound level meter as specified by ANSI S1.4-1971. The A-scale tends to suppress lower frequencies, e.g., below 1,000 Hz and best approximates the sound as heard by the normal human ear. It is the most widely used weighting system for assessing transportation-related noise.

Acoustically Representative: A receiver location which represents the same type and magnitude of noise as another location. For good acoustical representation roadway geometry, topography, traffic flow, distance from source to receiver should all be nearly the same.

Acoustic Energy: Commonly referred to as sound energy, or just plain energy, acoustic energy is arithmetically equivalent to $10^{[\text{Sound Pressure Level (SPL)}/10]}$, where SPL is expressed in decibels re 20 μPa (FHWA, *Measurement of Highway-Related Noise*, 1996, page 5).

Ambient Noise: All-encompassing sound that is associated with a given environment, excluding the analysis system's electrical noise and the sound source of interest (FHWA, *Measurement of Highway-Related Noise*, 1996, page 5).

Approach: This term has been defined by MDT as one decibel (dBA) below the Federal Noise Abatement Criteria (see Table 1 and Section 4.0).

Benefited Receptor: A dwelling unit expected to receive a noise reduction of at least 6 dBA from the proposed noise abatement measure, if the dwelling unit is a first-row home. A multi-story residence counts as one benefited receptor even if the proposed noise abatement provides 6 dBA for the exterior (e.g. balconies) of two or more floors or individual units. The definition is primarily used in the determination of noise abatement reasonableness. Second-row homes that receive at least a 4 decibel reduction in noise will be counted as benefited receptors. Apartment complexes of up to 4 units will be counted as one benefited receptor.

Date of Public Knowledge: The date that a project is approved, i.e., approval of the final environmental documentation is completed (e.g. Record of Decision).

Day-Night Average Sound Level (Ldn): A 24-hour time-averaged sound level, adjusted for average-day sound source operations. In the case of highway noise, a single operation is equivalent to a single vehicle pass-by. The adjustment includes a 10 decibel penalty for vehicle pass-bys occurring between 2200 and 0700 hours, local time (FHWA, *Measurement of Highway-Related Noise*, 1996, page 7).

Decibel (dB): A unit of level which denotes the ratio between two quantities that are proportional to power; the number of decibels is 10 times the base 10 logarithm of this ratio. For the purpose of this document, the reference level is 20 μPa, or the threshold of human hearing (FHWA, *Measurement of Highway-Related Noise*, 1996, page 8).

Design Year: The future year used to estimate the probable traffic volume for which a highway is designed. Design year is a time, usually 20 years, from the completion of construction.

Existing Noise Level(S): The current noise level, resulting from the natural and mechanical sources and human activity, considered normally present in a particular area.

First Row Homes: Homes that will be closest to a noise barrier or berm. Generally, first row homes will experience the highest reduction in noise with the construction this type of noise abatement.

FHWA Type I Project: A proposed Federal or Federal-aid highway project for the construction of a highway on a new location, or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment, or increases the number of through-traffic lanes.

FHWA Type II Project: A proposed Federal or Federal-aid project for noise abatement on an existing highway (refer to Section 2.1.2).

Impacted Receivers: Receivers – generally residences -- that will receive a traffic noise impact from the construction of a project.

Insertion Loss: The actual acoustical benefit derived from the construction of a noise barrier.

Leq: The equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period. Leq(h) is the hourly value of Leq (23 CFR 772.5).

National Environmental Policy Act (NEPA): Federal legislation that establishes environmental policy for the nation. It provides an interdisciplinary framework to ensure that decision-makers adequately take environmental factors into account.

Noise Abatement: Various design and/or traffic management measures taken to reduce or eliminate (mitigate) noise impacts.

Noise Abatement Criteria (NAC): FHWA-determined noise levels for various activities or land uses which represent the upper limit of acceptable traffic noise level conditions. These levels are used to aid in identifying traffic noise impacts.

Noise Barrier: sound walls or earth berms constructed to mitigate noise impacts. Sound walls, if constructed, generally must provide a 7dBA reduction in noise.

Noise Mitigation: See *noise abatement*, above.

Planned, Designed And Programmed: A noise sensitive land-use (subdivision, residences, schools, churches, hospitals, libraries) is considered planned, designed and programmed when it has received final development approval (generally the issuance of a building permit) from the local agency with jurisdiction.

Noise: Any unwanted sound.

Noise Barrier: A solid wall or earth berm, or combination of berm and wall, located between the roadway and receiver location, which breaks the line-of-sight between the receiver and the roadway noise sources.

Peak Traffic Hour: Highest hourly traffic volume in a 24-hour period.

Predicted Noise Level: Future noise levels, resulting from the natural and mechanical sources and human activity, considered being usually present in a particular area, including the project.

Receivers: Locations selected for determining traffic noise impacts. These locations should represent areas where frequent human use occurs or is likely to occur in the foreseeable future (e.g., vacant property for which development plans are planned, designed and programmed).

Substantially Exceeds: Design Year noise levels (Leq(h)) which are 13 decibels (dBA) or higher than existing noise levels.

Shielding: Any man-made or natural structure or barrier that provides a visual and/or auditory barrier between receiver and roadway or a portion of roadway. For example, rock outcrops, thick stands of trees, buildings.

Traffic Noise Impact: Impact that occurs at a receiver when one or both of the following takes place:

1. The predicted noise level *substantially exceeds* the existing noise level
2.
3. The predicted noise level *approaches* or exceeds the Noise Abatement Criteria.

Type I Project: A proposed Federal or Federal-aid highway project for the construction of a highway on a new location or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment or increases the number of through-traffic lanes (23 CFR 772.5)

Type II Project: A proposed Federal or Federal-aid highway project for noise abatement on an existing highway (23 CFR 772.5)

Vehicle Classes: Includes heavy trucks, medium trucks, automobiles, motorcycles and buses. Heavy trucks include any vehicle having three or more axles and designed for the transportation of cargo. Also included in this class are autos with trailers. Medium trucks include all vehicles having two axles and six wheels designed for the transportation of cargo. Automobiles include all vehicles with two axles and four wheels designed primarily for the transportation of nine or fewer passengers, or transportation of cargo (light trucks with two axles and 4 wheels). Optional vehicle classes of motorcycles and buses are available for use in TNM.

Worst-Case Noise Hour: Also called peak noise hour. A period of 60 minutes throughout a 24-hour day that reflects the peak noise hour, usually associated with peak traffic hour, but not in every instance.